stand out in remarkable relief because of the lack of fat, and are, I think, fully developed.

In marked contradistinction to this condition of the upper part of her person is the appearance of her abdomen, buttocks, and legs; these are plump, and present all the appearances of belonging to a very well-nourished child. In the thighs, the thickness of the skin and connective tissue as grasped between the thumb and finger seems to measure about half an inch; there is no pitting, although the tissues appear rather denser than usual. The color of the skin is everywhere good, and there is no mottling or change in temperature from the normal. The hair is light in color, is devoid of much natural moisture, and there is a marked tendency to the collection of dandruff. No change in the nails was noticed. The grasp of both hands is good, even more powerful than usual for a child of her age; she is strong, and is able to suspend herself for some time by her hands with her arms flexed, and while in this position all the muscles of the upper extremities can be plainly mapped out. There is no fibrillary twitching or wasting of the smaller muscles of the hands.

When told to rise from a supine position, she does so quickly, and without any effort or attempt to assist herself by placing her hands on her thighs; there is no curvature of the spine or spinal tenderness, and she can pick up an object from the floor in front of her quickly and with ease. The patellar knee-jerk is present on both sides, alike, and is normal. The abdominal reflexes are likewise good; tapping over the pectorals causes the usual slight fibrillary twitch extending laterally from the point struck; there is no chin reflex.

The pupils are normal in size, alike, and respond freely to light. The eyesight is good.

Over the outer surfaces of the lower part of both forearms towards the ulnar side there appears to be slight analgesia, pin-pricks causing but little feeling of discomfort, and bleeding but slightly. Elsewhere sensation is normal. The power to localize a touch is good even over the region of partial analgesia. Sensation in the legs normal. There are no signs of unilateral or partial flushings of the body or extremities.

Heart-sounds are normal, with the exception of slight accentuation of second sound at right base. Lungs and abdominal organs apparently perfectly healthy. Reaction to Faradic current, normal. Reaction to galvanic current, normal. Urine, normal. Eyes, normal.

ARTICLE VII.

THE PNEUMONIA-COCCUS OF FRIEDLANDER (*Micrococcus Pasteuri*, Sternberg).[1] By GEORGE M. STERNBERG, M.D., Surgeon U. S. Army.

IN this paper I desire to call attention to the so-called pneumonia-coccus of Friedlander, which I shall take the liberty of naming *Micrococcus Pasteuri*. My right to name the micrococcus discovered by Friedlander in the exudate of croupous-pneumonia must depend upon my ability to

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[1] Read before the Pathological Society of Philadelphia, April 17, 1885.

ake good the claim which I here state, viz.: that the pneumonia-coccus
'this author is, in fact, identical specifically with a micrococcus previ-
ısly described by me, which is found in normal human saliva, and with
at found by Pasteur in the blood of rabbits which had been injected
ith the saliva of a child who had died of hydrophobia in one of the Paris
spitals.[1]

In attaching to this micrococcus the name of the illustrious French
emist I have no desire to perpetuate the memory of the mistake he made
supposing for a time that it was the germ of hydrophobia. Having
und that this was a mistake, he did not fail to correct it; so no doubt
och will do if he has made a mistake in announcing his "comma-
cillus" as the much sought cholera-germ. It is easy to make mistakes
this field of investigation; easier, perhaps, than to acknowledge them.
nd believing, as I do, in human fallibility, I have no hesitation in ques-
oning the conclusions of the most illustrious workers in the field of micro-
ology, if they are in conflict with my own observations. On the other
nd, if, upon fuller investigation, I am convinced that I have been mis-
ken in regard to this or any other question, I shall feel no hesitation in
llowing the example of Pasteur in making a public acknowledgment of
y error. At all events the name will stand for the oval micrococcus
hich produces a fatal form of septicæmia in rabbits, and which is con-
antly present in my buccal secretions.

If I am right as to the specific identity of this micrococcus with the
icrococcus discovered by Friedlander in the exudate of croupous-pneu-
onia, it does not follow that Friedlander is wrong in assigning to this
ganism an etiological *rôle* in connection with this disease. This is a
uestion which I will not discuss at the present time, as I hope to make
the subject of experimental inquiry at as early a date as practicable.

In giving a specific name to a micrococcus which I first observed nearly
ve years ago, and which I have repeatedly studied by means of oil im-
ersion objectives—the one-eighteenth and one-twelfth inch hom. im. of
eiss—by the most approved methods of staining and cultivation, and by
umerous experiments upon animals, I can scarcely be accused of undue
aste. And, inasmuch as this is the first microörganism which I have
ttempted to name among the multitude which I have encountered in the
ourse of my bacteriological studies, I may be acquitted of any special
roclivity for conferring names upon supposed "new species," as is the
shion among amateur naturalists.

I have heretofore spoken of this particular micrococcus as "the micro-
occus of septicæmia in the rabbit;" but, as there is more than one form
f infectious septicæmia in the rabbit known to us by laboratory experi-
ents, each due to a different microörganism, this term is evidently

[1] Comptes rendus Ac. de Sc., 1881, xcii. p. 159.

inexact. Moreover, it would indicate that this particular micrococcus finds its usual habitat in the blood of rabbits affected with the form of septicæmia to which it gives rise. This is by no means true, for the organism in question is widely distributed, and it is only by inoculation experiments that the fact has been developed that it is a pathogenic species, as far as rabbits are concerned. I made this discovery in the summer of 1880, quite accidentally, having injected a little of my own saliva under the skin of a rabbit, as a comparative experiment, to ascertain whether a fluid supposed to be innocuous would give rise to any febrile disturbance. The promptly fatal result, and the presence of a multitude of oval organisms in the blood, at once aroused my attention, and, as is well known, I have since made numerous additional experiments, at different times and places, and always[1] with the same result: The animals die in from 24 to 48 hours; they present the same pathological appearances; their blood is infectious in the smallest quantity, and it contains vast numbers of the oval micrococcus which I now name *Micrococcus Pasteuri*.

Upon making sections of the tissues of a rabbit dead from this form of septicæmia, the oval micrococci are found in great numbers in the capillaries of the various organs, as I am prepared to show. Repeatedly I have produced this infectious disease in rabbits by injecting beneath their skin pure cultures of the micrococcus in question.

All this is a matter of record, and the experimental proof is as definite as is that offered by Koch in regard to the fatal form of septicæmia in mice which he has so well studied, or in the better known infectious disease, anthrax. Yet, in spite of my detailed record of experiments made, of my frequent repetition of these experiments, and of my photographs from nature which illustrate my first paper, published in 1881, and the article upon septicæmia in rabbits in my book,[2] which was published more than a year ago, I find in Klein's recent work[3] the following reference to my experiments:—

> "That saliva of the healthy dog, and of man inoculated subcutaneously into rabbits sometimes produces death in these animals [Senator] had entirely escaped his [Pasteur's] notice. Sternberg has proved this in an extensive series of experiments. His own saliva proved sometimes fatal to rabbits. They die of what is called septicæmia, and Sternberg thinks it due to the micrococci; but this is not to be considered as proved."

I claim that the fact is proved, and that the experimental evidence of this has been upon record for nearly four years, and I am prepared to repeat the experiments, and to demonstrate that such is the case. I look upon the fact that an infectious disease of a lower animal may be induced y inoculation with a microörganism which is habitually found as a harm- ss parasite in the mouth of man, as something more than a curious ircumstance to be recorded and forgotten, and as having an important earing upon vital questions relating to the genesis of "disease germs," uestions which are now largely occupying the attention of leading patho- gists in all parts of the world. But in the discussion of these questions must insist that experimental evidence obtained on this side of the tlantic is entitled to just as much consideration, as that which comes to s from across the water. And, unless the truth of my detailed account of xperiments made is impeached, I can only account for such a verdict as at which Klein has recorded in the sentence above quoted, upon the pposition that he has not read the evidence presented, or that he is con- olled by a geographical bias, unworthy a true student of science, in stimating its value.

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[1] In a few instances only, out of a large number of experiments, have rabbits survived the injection subcutaneously of a few minims of my saliva.

[2] Bacteria. Wm. Wood & Co., New York, 1884.

[3] Micro-organisms and Disease. 1885.

In the blood of rabbits recently dead, and in fresh cultures, *Micrococ- us Pasteuri* presents the appearance shown in Figs. 1, 2, and 5. The

Fig. 1.

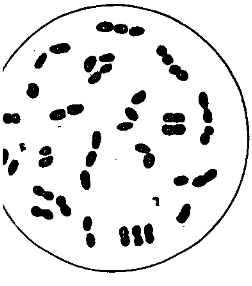

Fig. 2.

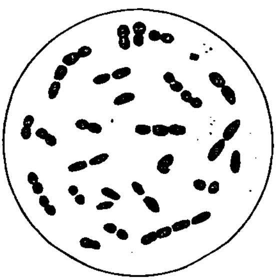

Fig. 1.—*Micrococcus Pasteuri* from blood of rabbit inoculated subcutaneously with normal man saliva (Dr. S.). Stained by the method recommended by Friedlander. Magnified 1000 ameters.

Fig. 2.—*Micrococcus Pasteuri* from blood of rabbit inoculated subcutaneously with fresh eumonic sputum from a patient in the seventh day of the disease. Same staining and ampli- ation as Fig. 1.

al elements vary considerably in their dimensions, and especially in ngth, and are seen solitary, in pairs, or in chains of three or four. When dergoing rapid multiplication they are commonly in pairs, but in surface ltures long chains are often formed as seen in Fig. 3. In these the indi- dual cocci approach more nearly to a spherical form than in the pairs countered in the blood of a rabbit just dead, where they are often so uch elongated as to appear rod-shaped. My observations indicate that ese rod-like forms are upon the point of division into two pairs of oval

Fig. 3.

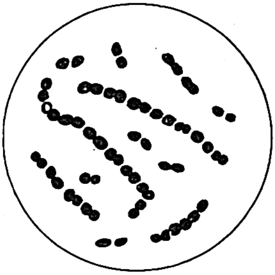

Fig. 4.

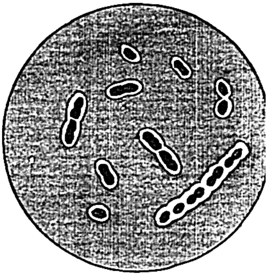

Fig. 3.—Surface culture of *M. Pasteuri*, showing development of long chains. Same stainin and amplification.

Fig. 4.—Surface culture of *M. Pasteuri* from blood of rabbit injected with pneumonic sputun showing the so-called "capsule" of Friedlander. Same staining and amplification.

elements, and, indeed, upon close inspection with high powers the commencement of transverse division may be recognized in each element o the pair. Morphologically, these pairs of oval or rod-like elements closel resemble the ordinary bacteria of putrefaction—*B. termo*, and might easil be mistaken for this organism. The supposition that they are identica is easily disposed of. Our micrococcus is, under all circumstances, motionless, while *bacterium termo* is an actively motile organism. *Micrococcu Pasteuri* is difficult to cultivate, being exceedingly sensitive as regard the composition and reaction of the culture medium. It does not giv rise to any putrefactive odor in fluids in which it is present in the greates abundance. In liquid cultures it only causes a slight opalescence of th culture medium, and its presence upon the surface of Koch's "flesh-peptone-gelatine" can only be detected by close observation. It does no liquefy the gelatine, and does not grow readily on the agar-agar gelatine In blood serum and in liquid culture media, it is seen with difficulty unde the microscope, owing to the fact that its refractive index does not diffe greatly from that of the fluid containing it. On the other hand, *B. term* thrives in any medium containing gelatine, or albumen, and causes this t undergo putrefactive decomposition.

The pneumonia coccus of Friedlander is also described as oval in form or as being found in pairs and in short chains. According to Talamon "it has the form of a grain of wheat, of from 1 to 4 μ in length, and one half to 1 μ in diameter. It is isolated, more frequently in pairs, an sometimes in chains of four." This corresponds with the description have given of *M. Pasteuri*. During the past winter I have made th acquaintance of this micrococcus as it appears in pneumonic sputum, an find that morphologically it does not differ from my *Micrococcus Pasteuri.*

But how about the "capsule" which Friedlander has described as the istinguishing character of the pneumonia-coccus? Dr. Friedlander's rst communication was made to the Medical Society of Berlin, on the 9th November, 1883, and this capsule was described as something quite iew, and as characteristic of the pneumonia-coccus. In the spring of 1881 made the accompanying photo-micrograph (see Fig. 6), in which oval nicrococci in pairs and chains of three or four elements are surrounded by capsule exactly resembling that described by Friedlander in his comnunication made two years later. This photo-micrograph was reproduced y the heliotype process, and appears as one of the illustrations which accompany my paper on "a fatal form of septicæmia in the rabbit," published n vol. ii., No. 2, of *Studies from the Bibliographical Laboratory* of Johns Hopkins University. This journal, however, is not likely to come under he eye of medical men, and it is not surprising that the paper referred o had escaped the attention of Friedlander. The same paper was pubished in the *Bulletin of the National Board of Health*, of April 30, 1881, ut without the heliotype illustration. The micrococci with "capsules" re also shown in Fig. 3, of Plate VI., in my book on "Bacteria," pubished in 1884.

Fig. 5.

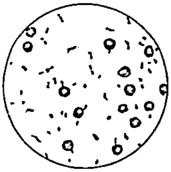

Fig. 6.

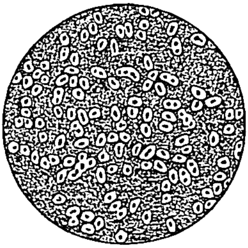

Fig. 5.—"Pneumonia coccus" (*M. Pasteuri*) "in the pericardial exudate of a rabbit dead with brinous pneumonia, double pleurisy, and pericarditis from an inoculation with the cultivated icrobe." (After Talamon, taken from Prof. Germain Sée's recent work—*Des Maladies Specifiques du Poumon*—in which it is Fig. 2 of Plate 1.) Amplification not stated.

Fig. 6.—From a photo-micrograph made by the author of this paper in 1881, and used in April f that year to illustrate a paper on "A fatal form of septicæmia in the rabbit induced by the ubcutaneous injection of human saliva." The preparation is from the blood of a rabbit recently ead, and is stained with an aqueous solution of iodine and potassic iodide. Magnified 1000 iameters. Photographed with Zeiss's one-eighteenth inch hom. oil im. objective.

Unfortunately a mistake has been made in the descriptive text facing his plate in my book, where the statement is made that the micrococci in this figure were stained with methyl-violet. This mistake was due to a fault of my memory, and to a failure to refer to my original paper published more than two years before, where the statement is clearly made that "in these photographs the staining was effected with iodine solution." (p. 196.)

Another mistake occurs in the same page of descriptive text, which I take this opportunity to correct. The reference to Fig. 3, in the eighteenth line, should have been to Fig. 4, and the text should read, "believed to be identical with those shown in *Fig.* 4, and with *micrococcus ureæ*"—referring to a micrococcus which is especially distinct from our *M. Pasteuri.*

There can be no question as to the morphological identity of the micrococcus represented in this photo-micrograph with that described by Friedlander, and the capsule was brought out in the specimen from which this photo-micrograph was made by the use of the same staining solution which Friedlander recommends for its demonstration, viz., a weak aqueous solution of iodine dissolved by the aid of potassic iodide. In my paper referred to I say, "In these photographs the staining was effected with iodine solution," and a little further on I give the formula as follows "(iodine grains iii, potassic iodide grs. v, distilled water grains 200)." In the same paper I give the following account of this envelope of mucous material which Friedlander describes as a capsule.

> "The most striking morphological difference between the micrococcus, as shown in Figures 2, 3, and 4, and in Figure 1, is the aureole which surrounds the well-defined dark central portion in the latter figure.
>
> "Pasteur says of this appearance: 'This organism is sometimes so small that it may escape a superficial observation. . . . It is an extremely short rod, a little compressed towards the middle, resembling a figure 8. . . . *Each of these little particles is surrounded at a certain focus with a sort of aureole which corresponds perhaps to a material substance.*'
>
> "Pasteur's inference that this aureole represents a material substance, and is not simply the result of diffraction, is fully sustained by my observations and my photographs. The slighter aureole seen in Figures 2 and 3 is probably a result of diffraction; but the use of aniline violet as a staining fluid promptly demonstrates that in Figure 1 we have to do with a material substance. The refractive index of this substance must be very nearly that of blood-serum, for it is with great difficulty that this aureole can be distinguished without the aid of staining material. It may be seen by the practised eye with a good immersion lens, but, as already mentioned, even the darker central portion, which alone is seen at first, may easily escape observation, and a false impression is obtained as regards the real size of the organism. When, however, a small drop of blood, dried upon a thin glass cover, is immersed for a minute or two in a solution of aniline violet, and then washed and examined with, even, a good one-fifth inch objective, the observer will be astonished to find a multitude of organisms, solitary, in pairs, and in chains, having a diameter of more than 1 μ, and mostly possessing an oval or elongated form, which might lead to the inference that they should be referred to the genus *Bacterium* Duj., rather than to *Micrococcus* Cohn.
>
> "The reason of this apparent change in dimensions as the result of staining is that the substance which constitutes the almost invisible aureole is deeply stained by the aniline, and the central portion, which was before seen because of its highly refractive index, is now lost to view in the uniform and deep violet color which the whole organism possesses."

Friedlander says with regard to his so-called capsule that several micro-hemical tests justify the conclusion that it consists of mucine, or of a ubstance resembling mucine. His account shows that it is not constantly resent, and varies greatly as to the extent of its development. In this his neumonia-coccus also corresponds with my *Micrococcus Pasteuri.* The levelopment of this external envelop of mucine to the extent shown in my hoto-micrograph is altogether exceptional. I have not yet ascertained he exact conditions which control the development of this envelope, but elieve it to be most marked in a rich culture-medium, and as a result f an exceptionally vigorous and rapid development of the micrococcus.

Friedlander says: "The formation of capsules appears to be an attri-ute of the pneumonia cocci at the highest point of their development."[1]

Prof. Germain Sée, in his recent work,[2] after giving an account of riedlander's method of staining, says:—

> "Friedlander attaches such an importance to the capsule of the micrococcus hat he declares that it is never wanting in acute fibrous pneumonia, and that in ll the other forms of pneumonia studied by him he has only found cocci without apsules. Nevertheless we must hasten to say, this capsule has no value whatever. alamon does not refer to it. According to him it does not belong to the coccus; t is the result of the mode of preparation and staining of the exudate. It is met ith in various microbes found in bronchial mucus treated by the method of riedlander. This is also the opinion of Professor Cornil. He says: 'We be-ieve, M. Afanassiew and myself, that the appearance is due simply to a retrac-ion of the liquid around the micro-organism, and that the capsules are produced rtificially.' On the other hand, Fraenkel, at the Medical Congress in Berlin of 884, declares that the formation of the capsule is not a constant phenomenon; hat this capsule is formed in other schizomycetes; finally that it is not possible consider the capsules as characteristic of the micrococcus of pneumonia. riedlander himself, at the same Congress, replying to Fraenkel, has given the last low to this famous capsule, in admitting that that which characterizes the micro-occus of pneumonia is neither the capsules, nor its cultures in nail-form, but the um of the morbid phenomena which it determines. There should then be no rther question of micrococci with capsules. It is the form of the microphyte hich ought to be taken as characteristic, joined to its pathologic effects as hown by inoculation." (Op. cit., p. 98.)

A second distinguishing character assigned by Friedlander to his pneu-onia-coccus was its peculiar nail-like mode of growth in gelatine cultures. lein has made the curious mistake of speaking of the coccus itself as ail-shaped. In his recent work,[3] he says (p. 329): "They are oval, of *peculiar nail-like shape,* about 0.001 mm. long," etc.; and again on the llowing page: "The micrococci were of *the peculiar nail-like shape,* and ere characterized by a mucinous capsule."

Prof. Sée, in the work above referred to, shows that the nail-like rowth in gelatine cultures is after all not a character of any great value, nd that the body of the nail is formed by the growth of the organism along the track of the inoculating needle, and the head by a little knot upon the surface of the gelatine at the point of entrance. Professor Sée says:—

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[1] From a review by Warwick in Centralbl. f. kl. med. Wissensch., Berl. 1884, No. 7, 107.

[2] Des Maladies spécifiques du Poumon, Paris, 1885.

[3] Micro-organisms and Disease, London, 1885.

> "According to Friedlander the cultures have a peculiar aspect: upon the surface of the gelatine a little elevation is formed from which a whitish substance extends downwards into the nutrient gelatine. This is what the German author speaks of as a nail-shaped culture. The coccus develops at the temperature of the chamber and does not liquefy the gelatine. Here again Friedlander has been mistaken, in describing this aspect of the culture as a peculiarity of the pneumonia microbe. The nail form does not depend upon the organism, but upon the manner in which one introduces it into the gelatine-peptone, by means of a platinum wire." (Op. cit., p. 90.)

At the same time that Friedlander was pursuing his researches with reference to the etiology of pneumonia in Berlin, Talamon was engaged in similar studies in the laboratory of the Hôtel-Dieu in Paris. His first communication was made to the Anatomical Society, November 30, 1883, a few days after Friedlander's communication to the Medical Society of Berlin. This author has nothing to say about a capsule. The morphology of the organism found by him in the pneumonic exudation, drawn from the lung during life by means of a hypodermic syringe, or obtained post-mortem, corresponds with that of my *Micrococcus Pasteuri*, as will be seen upon referring to Figure 5, which is copied accurately from an illustration in the recent work of Professor Germain Sée, already referred to. Talamon experimented upon twenty rabbits, two guinea-pigs, four dogs. Injections of liquid cultures directly into the pulmonary tissue of the guinea-pigs and dogs gave a negative result. Of twenty rabbits inoculated in the same manner with the exudate from cases of pneumonia, or with liquid cultures, four recovered after showing symptoms of being sick for five or six days; the others died. Of those which succumbed, two presented no alterations of the lungs, which were scarcely congested, but a "fibrino-serous pleurisy" and fibrinous pericarditis were found. In eight rabbits there was fibrinous pneumonia, sometimes involving an entire lung, sometimes only the inferior lobe. In these cases also there were pleurisy and pericarditis with fibrinous and serous exudation. The blood of the rabbit contained the oval micrococcus in abundance. I call attention here to the fact reported in my first paper on "a fatal form of septicæmia in the rabbit," viz.: that the guinea-pig is less susceptible than the rabbit, and that the dog shows no susceptibility. Nevertheless two out of three of my guinea-pigs succumbed, one in three and one in seven days, while Talamon's guinea-pigs did not die. Moreover, Talamon injected six rabbits subcutaneously, and these all withstood the injection, and showed no special indications of ill-health. If then the organism injected was the same as that which I have found to kill rabbits almost without fail, within forty-eight hours, we must admit at least that it has not the same pathogenic potency. My own observations lead me to believe that this micrococcus when obtained from the same source differs in pathogenic powers at different times, and that while probably present in the saliva of healthy persons generally, it has not in all cases the same degree of pathogenic power. Thus, in my original experiments, I report as follows:—

> "The saliva of four students, residents of Baltimore (in March), gave negative results; eleven rabbits injected with the saliva of six individuals in Philadelphia (in January) gave eight deaths and three negative results; but in the fatal cases, a less degree of virulence was shown in six cases by a more prolonged period between the date of injection and the date of death. This was three days in one, four days in four, and seven days in one."

I also mention the fact that the buccal secretions of two Cuban gentlemen, medical students in Philadelphia, proved to be quite as virulent when injected beneath the skin of rabbits as my own. This, taken in connection with the circumstance that I have spent much time in the South, led me to think that possibly this unusual degree of pathogenic power might be due to the fact that the variety of the micrococcus to which it is due, and which is constantly in cultivation in my mouth, came from a southern latitude. This supposition receives some support from the experiments of Claxton[1] made in this city, at the University of Pennsylvania, in 1882. The results reported were in general in conformity with those previously reported by myself, but they showed that the saliva of all persons does not exhibit the same pathogenic potency as manifested by its effects upon rabbits, for of eighteen rabbits injected with the saliva of seven individuals four recovered, five died in less than five days, four in five to ten days, and four in ten to fifteen days. Claxton remarks: "I also have observed the same remarkable virulence in the residents of tropical countries, as Cuba and Brazil, as also in the case of negroes, the saliva of which latter race exhibits it to an extreme degree."

The difference in pathogenic power shown by this oval micrococcus as found in the buccal secretions of healthy individuals corresponds with a difference in the results obtained by three different experimenters who have injected pneumonic sputum into rabbits, in different latitudes. Thus Friedlander reports a negative result from nine injections made through the thoracic walls, while Talamon had sixteen fatal cases out of twenty injected, and Salvioli,[2] whose experiments were made in Italy, reports a uniformly fatal result, within forty-eight hours, from similar injections made into four rabbits. The greater pathogenic power of the material injected by Salvioli is shown by the fact that his rabbits all died within forty-eight hours, and also by a uniformly fatal result from injections into guinea-pigs (9). The pathological appearances resulting from the injections practised in these two species of animals were identical, and correspond with those which I had previously obtained from the injection of normal human saliva. All of the authors mentioned refer to tumefaction of the spleen, as a constant result. Both Talamon and Salvioli refer to the abundant presence of the oval micrococcus in the blood, and effused serum in the pleural cavity, of animals which have succumbed to the injections made. The paper of Salvioli is illustrated by some very well-drawn figures, which illustrated the morphology of the organism found by him in the pneumonic exudate and in the blood of animals into which this has been injected. Fig. 7 is copied accurately from this author's Fig. 2, and shows that his pneumonia coccus is identical morphologically with my *Micrococcus Pasteuri*. The results obtained by the author last mentioned, like those of Talamon and of Friedlander, are supposed by their author to establish the fact that croupous pneumonia is an infectious disease. Without denying this fact, we submit that these results are in conformity with the claim made in the present paper as to the specific identity of the oval micrococcus found constantly in the pneumonic exudate with the micrococcus found in normal human saliva which produces an infectious form of septicæmia in rabbits. In support of my claim as to the physiological identity of the oval micrococci from these two sources I offer the following literal translation of the experiments of Salvioli upon rabbits:—

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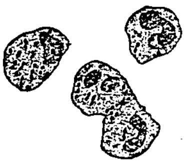
[1] Philadelphia Medical Times, June 17, 1882.

[2] G. Salvioli. Natura infettiva della pulmonite crupale. Arch. per le scienze Mediche, vol. viii. pp. 127-148 (1884).

Fig. 7.



Copied from illustration accompanying the paper of Dr. G. Salvioli in the *Archivo per le Scienze Mediche*, Turin, vol. viii. Tar. viii. Fig. 2. "Cells of the pleuritic exudation containing pneumonia cocci, mounted in Canada balsam." Stained with gentian violet.

"*Jan.* 17, 3 *P. M.*—Rabbit weighing 1970 grammes; very thin when purchased. Injected into right thoracic cavity, 1.5 c. c. of the usual exudation. The rabbit died at 10 A. M. on the 19th. At the post-mortem examination made immediately after death we noted: collection of turbid serum in the right pleural cavity which coagulated after being drawn. Fibrinous pseudo-membrane upon the surface of the lung, especially the inferior lobe. Lung, especially the inferior lobe, enlarged and congested, contains little air. Upon section a little serum escapes from the surface. Spleen congested. Characteristic pneumonia cocci in the pleuritic exudation; not in spleen. Upon microscopical examination of an indurated piece of lung, micrococci were found in the costal and visceral pleuræ, and in the pulmonary tissue, presumably between the lymphatics; and in the pulmonary alveoli. Near the pleura a slight collection of fibrinous exudation."

"*Jan.* 20, 3 *P. M.*—Rabbit weighing 2080 grammes, of Sardinian race, of exceptional resistance, and therefore adapted for the experiment. Injected into right thoracic cavity 1 c. c. of the exudate from the dog"—killed at a previous experiment.

"At noon on the 21st the rabbit was found dead. At the autopsy a turbid liquid, rich in pneumonia cocci, was found in the right pleural cavity; infiltration of the mediastinal cellular tissue by a turbid serum rich in cocci, fibrinous pseudomembrane upon the right pleura. Spleen enlarged, and with cocci; in its pulp. At the examination of a hardened specimen cocci were found in the pleura, visceral as well as parietal, and also in the pulmonary tissue in the vicinity of the pleura. In this, also, was found a little of the fibrinous exudation in the alveoli."

"On the 28th I received another specimen of exudate from the medical clinic, which had been extracted[1] from a patient with fibrinous pleuro-pneumonia, in the twelfth day of sickness. The slightly turbid liquid had an alkaline reaction and pale yellow color. When allowed to stand a sediment was deposited corresponding to one-eighth of the liquid column. A microscopic examination of the sediment showed the presence of leucocytes, red globules, a quantity of granular material, and some very rare pneumonia cocci, but slightly stained, notwithstanding a repetition of the preparation; instead I observed some smaller granules which did not take the color, which resisted drying, and which I have called spores. This exudate I injected into two guinea-pigs, two rabbits, and two dogs. *Only the rabbits gave me a favorable result.*[2] The other animals survived and did not present the slightest disturbance."

"*Jan.* 28, 1 *P. M.*—Rabbit weighing 1920 grammes, injected into right thoracic cavity 1 c. c. of the above serum after mixing up the sediment. The rabbit was found dead on the morning of the 29th, and at the autopsy there was an abundant, urbid, sero-fibrinous, exudation in the right pleural cavity, fibrinous pseudo-membrane upon the pleura. The cellular tissue of the mediastinum was infiltraed with turbid serum, parenchyma of right lung partly deprived of air by compression, with this exception normal, [free translation for '*del resto nulla di articolare.*'] Spleen enlarged; pneumonia cocci in the pleuritic exudation and n the splenic pulp. At the microscopic examination of a hardened piece the neumonia cocci were found in the pleura, in the pulmonary tissue also, at a disance from the pleura.[3] In some alveoli, in the vicinity of pleura, was found a brinous exudation.

"*Jan.* 28, 2 *P. M.*—Rabbit weighing 1890 grammes; injected into right thoacic cavity 1 c. c. of limpid serum. On the morning of the 31st the rabbit died, nd at the autopsy were found turbid exudation in right pleural cavity, fibrinous seudo-membrane upon the pleura, right lung enlarged, resistant, non-crepitant; ie inferior lobe presented the aspect of red hepatization, pronounced tumefaction f the spleen. The characteristic pneumonia cocci were found in the exudate, the pulmonary juice, and in the splenic pulp."[4]

I shall now record some recent experiments made by myself.

November 29, 1884.—Inoculated rabbit subcutaneously with pneumonic utum brought to me by a medical gentleman in Baltimore, from a patient, ged 60, in the sixth day of the disease. The doctor had carried this utum in his pocket for twenty-four hours before handing it to me. esult negative.

January 2, 1885.—Inoculated two rabbits subcutaneously with pneuonic sputum, collected with great care by my friend, Dr. Rohé, and ought to me at once—from a white male patient, aged 19, in the seventh y of illness, second day of bloody expectoration. Both rabbits were und dead on the morning of January 4. In both the pathological aparances were identical with those constantly observed by me in rabbits lled by the subcutaneous injection of my own saliva, viz., extensive inflamatory œdema extending from point of injection, enlarged spleen, and esence of oval micrococci in blood and in effused serum in the subcuneous connective tissue. Fig. 2 is drawn from a slide mounted at the ne, and represents this micrococcus as seen in the blood.[5]

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[1] I understand that the liquid was extracted from the pleural cavity by an aspirating inge, although this is not distinctly stated.—G. M. S.

[2] Italics by translator.

[3] They had invaded the blood and were distributed through the capillaries generally. G. M. S.

[4] Op. cit., p. 133.

[5] This and the other figures illustrating the present paper are from camera lucida wings made by my laboratory assistant, Dr. A. C. Abbott, of Baltimore.

Remarks.—It may be asked whether possibly my *Micrococcus Pasteuri* may not have been present, accidentally, in the pneumonic sputum, as a result of the fact that the exudate into the alveoli of the lungs must come in contact with the buccal secretion of the patient when it is expectorated. In reply to this supposition I would say that I have a slide, which I shall be happy to submit for the inspection of the microscopical experts, which shows the capsule of Friedlander in a most beautiful and unmistakable manner. This slide is from a surface culture which was started from the blood of one of these rabbits inoculated with pneumonic sputum. (See Fig. 4.) I cannot, then, doubt that this is in truth the micrococcus described by Friedlander, and, as in the blood of the rabbits, it was identical morphologically with my *Micrococcus Pasteuri* (compare Figs. 1 and 2), and shows identical physiological characters when injected beneath the skin of these animals, I feel justified in assuming the specific identity of the micrococci from the two sources.

March 14.—Four rabbits were injected subcutaneously with a small quantity (about 1 c. c.) of my own saliva. Two of these rabbits were found dead on the morning of March 16, and the other two died during the morning. All presented the usual pathological appearances so often described, viz., enlarged spleen, extensive subcutaneous œdema, slight hemorrhagic extravasations, etc. The blood of all of these rabbits contained the oval micrococcus in abundance. (Fig. 2 is drawn from a preparation mounted at the time.) Cultures were started from this blood, and served for the following experiment.

March 31.—I injected into the thoracic cavity of two rabbits, by means of a hypodermic syringe, a small quantity of a culture of *M. Pasteuri*, in Koch's flesh-peptone gelatine. Both rabbits were found dead the following morning. In both the pleural cavity contained turbid serum, and there was a fibrinous deposit upon the surface of the lung on the side (right) into which the injection was made. The margin of the lung in one appeared congested, but there was no inflammation of the lungs, which floated in water.

Remarks.—Death occurred in these cases more promptly than when I have injected the same material subcutaneously. This is not surprising, for it seems probable that the blood would be invaded by the parasite more promptly when it it is thrown into the pleural cavity than when injected subcutaneously. As a matter of fact, in injecting saliva, or culture fluids subcutaneously I have observed that the animal commonly presents no indications of being ill during the first twenty-four hours, and that during this time the inflammatory œdema at the point of puncture has made but little progress, as shown by the slight extent of local tumefaction. The pleurisy and fibrinous exudation upon the surface of the lung in these rabbits correspond with what the authors above referred to have reported as a result of the injection in the same way of pneumonic exudate. It may be that if death had not occurred at so early a period, the lungs would have become involved, and that these cases could have been placed

Beside those reported by Talamon, in which unmistakable pneumonia is aid to have been produced by the injection into the thoracic cavity of abbits, of pneumonic exudate, or of culture fluids. The superior pathogenic potency of the micrococcus in my experiment above reported is shown by the brief period between the time of injection and the date of death. But, although this period was less than twenty-four hours, the blood of hese rabbits, as well as the effused serum in the pleural cavity, contained he oval micrococcus in vast numbers.

I have been led to suspect, from the fact that while fibrinous pleurisy is a constant result in the experiments reported by Talamon and by Salvioli, fibrinous exudation in the lung tissue is only occasionally found, hat perhaps the development of pneumonia depends upon the penetration of the lung by the point of the syringe and the injection of the infectious material directly into the lung substance. I can easily understand how his result might occur, if the local effect of the presence of the micro- occus in the lung is the same as when it is introduced into the subcutaneous connective tissue, that is the infiltration of the tissue with an nflammatory exudate, which gives rise to the appearance which I have generally spoken of as an inflammatory œdema.

April 7th, 4 P. M.—Injected through the walls of the thorax, on the ight side, by means of a hypodermic syringe, a small quantity of pneumonic sputum, from a case in the practice of Dr. Mitchell. The sputum was collected with due care by my laboratory assistant Dr. A. C. Abbott. Both rabbits were found dead the following morning. There was con- iderable turbid serum in the right pleural cavity, and a fibrinous deposit pon the surface of the lung of the same side. The lung floated in water nd gave no evidence of being inflamed, but was stained of a reddish olor. The spleens of these rabbits were but slightly enlarged.

Remarks.—I have frequently noticed that in cases so quickly fatal, umefaction of the spleen is not so marked as in cases of longer duration. The blood of one of these rabbits contained the oval micrococcus in great bundance; blood drawn from the femoral vein of the other contained a mall number of the same organism, in pairs and chains of three or four. The turbid serum from the pleural cavity contained the microbe in great umbers.

Since the above was written the following experiment has been made :—

On the afternoon of April 9th Dr. Councilman, Assistant in Pathology n Johns Hopkins University, and Pathologist at Bay View Hospital, anded me a portion of hepatized lung from a case of pneumonia at Bay View, n which the post-mortem examination was made within six hours after eath. The exudate, scraped from a freshly-cut surface of the lung tissue, was spread upon thin glass covers, and stained by the method recommended by Friedlander for the demonstration of his so-called pneumonia-coccus. Micrococci of oval form in pairs and in chains of three or four elements ere found in abundance, but they were not surrounded by a capsule.

April 9th, 4 P. M.—A little of the exudate, scraped from a freshly cut section of the hepatized lung above referred to, was mixed with distilled water and injected into the right thoracic cavity of a small rabbit, by means of a hypodermic syringe. At the same time a little of my own saliva was injected into another small rabbit, of the same litter, in the same manner. Rabbit No. 1, injected with pneumonic exudate, was found dead on the morning of April 12. Upon opening the cavity of the thorax the lungs were found to present a normal appearance, except that the inferior lobe of right lung had a blood-red color, apparently due to a hemorrhagic infarct; both lungs floated in water. The right pleural cavity contained turbid serum, in which, as well as in the blood, the presence of numerous oval micrococci was demonstrated by microscopical examination. Several specimens were stained by the method recommended by Friedlander, but no distinct appearance of a capsule was made out. The spleen was considerably enlarged.

On the morning of April 13, rabbit No. 2 was found dead. There was but slight evidence of pleurisy, but the right lung was indurated, of a gray color, and sank in water.

Remarks.—The spleen of this rabbit was not enlarged, and its blood did not contain the septic micrococcus. The development of pneumonia in this case was doubtless due to the fact that the point of the syringe had penetrated the lung, and the injection had been made directly into the lung tissue. Such a result must depend to a great extent upon accident, and in making injections through the thoracic walls it is impossible to say in advance of the *post-mortem* examination whether the fluid has been injected into the pleural cavity or into the lung substance.

A microscopical examination of the lung after it had been hardened in alcohol showed that there was a necrotic focus of some extent surrounded by an extended area of indurated lung tissue, which presented the appearance of catarrhal rather than of croupous pneumonia. There was also interstitial hemorrhage in the vicinity of the necrotic centre, and there can be little doubt that this marked the point to which the syringe had penetrated when the injection was made. The oval micrococcus was not found in the inflamed lung tissue, and I am not able to ascribe to it any special import in the development of the inflammation in this particular case.

I must now refer to Friedlander's experiments upon mice, guinea-pigs, and dogs, and shall quote from the recent work of Prof. Sée already referred to:—

> "All of the mice succumbed in from eighteen to twenty-eight hours after the injection. At the autopsy the lungs were found to be highly congested, almost empty of air, and to contain foci—*noyaux*—of red induration. Out of eleven guinea-pigs six died with pneumonic lesions. Out of six dogs one only succumbed. In another series of experiments mice were made to inhale a spray of a culture fluid containing the coccus in suspension. Several of these animals succumbed. At the autopsy Friedlander says that he found the appearance of typical pneumonia, and verified the presence of numerous micrococci with capsules in the lungs, the spleen, the blood, and the pleural liquid." (Op. cit., p. 90.)

I would like to inquire how it is that to produce pneumonia in animals Friedlander and his followers consider it necesary to introduce the infectious material into the pleural cavity or into the substance of the lung itself with a sharp-pointed instrument. If this coccus is the germ of infectious pneumonia, one would think that to inject it subcutaneously ought to give rise to the local-lesion, just as the subcutaneous injection of tuberculous sputum gives rise to tuberculosis of the lungs. We find from the accounts given that when injected into the lung or introduced by inhalation, the micrococcus invades the blood, and produces enlargement of the spleen; but to produce the characteristic local inflammation which it is supposed to be the especial function of this micrococcus to produce, it does not suffice to inject the micrococcus beneath the skin or into the blood; it must be injected through the walls of the thorax with a sharp-pointed syringe. And when so injected only a certain proportion of the animals have pneumonia. Prof. Sée, while accepting Talamon's experiments upon rabbits as demonstrating the infectious nature of croupous pneumonia, is not inclined to accept the demonstration which Friedlander claims to have made by his experiments upon mice. He says:—

> "The rather brief description of the lesions in the mouse, which Friedlander has given, leaves some doubt in the mind; for the presence of centres—*noyaux*—of induration in the congested lungs does not suffice to characterize fibrinous pneumonia."

I would here call attention to the fact referred to in my first paper on a fatal form of septicæmia in the rabbit, viz: that in this infectious disease there are sometimes found hemorrhagic infarcts in the lungs. I quote from this paper as follows:—

> "Pasteur says, 'The lungs are frequently filled with the *noyaux* of pulmonary apoplexy.' (I have found this to be the case in one out of three rabbits examined since my attention has been directed to this point.) 'A character more constant than the last (not more constant, however, than that which relates to the volume and color of the *ganglions*), is the state of the trachea, which is almost invariably red, congested, with little hemorrhages from the smallest vessels.' (I have found a marked congestion of the vessels of the trachea in the three cases in which I have examined it, and in one case the lymphatic glands of the axillæ were enlarged and congested.)"

The possibility has frequently occurred to me that this same micrococcus may be concerned in the etiology of diphtheria. The fact that it causes inflammatory œdemà of the subcutaneous connective tissue, and that when introduced into the pleural cavity it causes a copious fibrinous deposit upon the lung, taken in connection with the fact that it has been shown to be a pathogenic organism having different degrees of potency under different circumstances, seems to justify the suspicion that there may be a pathogenic variety which has a special propensity for locating itself in the mucous membrane of the fauces. Certainly the suddenly developed inflammatory œdema and fibrinous exudation which characterize malignant diphtheria, correspond with the local effect produced when this micrococcus is inoculated into susceptible lower animals. The experiments of Löffler[1] seem to show that the widely-distributed spherical micrococcus which forms long chains and zooglœa masses is not the germ of diphtheria, and this observer speaks of a *bacillus* as being found in the deeper portion of the pseudo-membrane in cases of diphtheria. I have no exact information as to the morphology of this bacillus, but knowing that, in the nomenclature of some bacteriologists, the same micrococcus is reserved exclusively for spherical organisms, I am not prepared to dismiss this supposition without further investigation.

I herewith submit the following conclusions for consideration:—

The pneumonia-coccus of Friedlander is identical specifically with the micrococcus previously described by me, and which is commonly found in normal human saliva. The capsule, or mucous envelope, which sometimes surrounds this micrococcus, described by Friedlander in 1883, and photographed by me two years previously, cannot be accepted as a distinguishing character of this species, inasmuch as it is not constantly present, and the circumstances upon which its development depends have not been accurately determined. It is established that this is a pathogenic organism, as far as certain lower animals are concerned, and that its pathogenic power varies under different circumstances. It seems extremely probable that this micrococcus is concerned in the etiology of croupous pneumonia, and that the infectious nature of this disease is due to its presence in the fibrinous exudate into the pulmonary alveoli.

But this cannot be considered as definitely established by the experiments which have thus far been made upon lower animals. The constant presence of this micrococcus in the buccal secretions of healthy persons indicates that some other factor is required for the development of an attack of pneumonia; and it seems probable that this other factor acts by reducing the vital resisting power of the pulmonary tissues, and thus making them vulnerable to the attacks of the microbe. This supposition enables us to account for the development of the numerous cases of pneumonia which cannot be traced to infection from without. The germ being always present, auto-infection is liable to occur when from alcoholism, sewer-gas poisoning, crowd-poisoning, or any other depressing agency the vitality of the tissues is reduced below the resisting point. We may suppose also that a reflex vaso-motor paralysis, affecting a single lobe of the lung, for example, and induced by exposure to cold, may so reduce the resisting power of the pulmonary tissue as to permit this micrococcus to produce its characteristic effects.

Again, we may suppose that a person, whose vital resisting power is reduced by any of the causes mentioned, may be attacked by pneumonia from external infection with material containing a pathogenic variety of this micrococcus having a potency, permanent or acquired, greater than that possessed by the same organism in normal buccal secretions.

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[1] I have not the paper of this author at hand, and am indebted to an editorial in the *Medical Record* of Jan. 31 for the facts here given.

The figures which illustrate this paper are from the following sources:—

Figures 1, 2, 3, and 4 are from camera lucida drawings made by my laboratory assistant, Dr. A. C. Abbott, of Baltimore, to whom I am also indebted for valuable assistance in conducting the recent experiments herein recorded. The drawings were made with an amplification of 2500 diameters, obtained by the use of a Geiss's one-eighteenth inch homogeneous oil immersion objective and a high eye-piece (Powell and Lealand large stand, tube drawn one inch). These drawings have been reduced by photography to two-fifths, in order to give an amplification of 1000 diameters in the figures.

ARTICLE VIII.

THE REFRACTION OF THE HUMAN EYE. A CRITICAL STUDY OF THE STATISTICS OBTAINED BY EXAMINATIONS OF THE REFRACTION, ESPECIALLY AMONG SCHOOL CHILDREN.

By B. ALEX. RANDALL, A.M., M.D., Ophthalmic and Aural Surgeon to the Episcopal and the Children's Hospitals, Phila.

THE great importance of full sharpness of vision is a matter which is steadily obtaining wider-spread recognition, and is demanding still more earnest consideration of all thinking persons. Defective sight is growing more notable for a variety of reasons, and the means of amending it are progressively improving and are more widely employed, thus furnishing constant reminders of the need of such help; yet they are making only the more distinct those classes of cases which are but partially, if at all, remediable, and driving us to the more thorough study of the causes of these defects and the means for their prevention. The progress which has been made in all branches of knowledge, especially the natural sciences, is constantly increasing the field to be covered in the usual educational process. The demands made upon children at their lessons have steadily increased; while the assumption of the matter of education by the state, as a duty owing to itself and its citizens, has carried the influence of the schools, sometimes by compulsion, into every rank of life. Conditions, therefore, which not long since invested only the few, are now the environment of the community. Census reports point to a steady and rapid decrease, in every country making claim to civilization, of that portion of its inhabitants unable to read and write; while means and attractions to the exercise of these powers are offered by veritable floods of literary productions and reproductions, by postal facilities which would have been deemed a few decades since utterly beyond belief, and by an immense broadening, for